BISMUTH OXIDE-BASED ELECTRODE-ELECTROLYTE PAIR (VARIANTS), METHOD FOR THE PRODUCTION THEREOF (VARIANTS) AND ORGANOGEL
Examiner: Scully S.N.: 10/559,541 Art Unit: 1795 October 21, 2008

Election/Restrictions

1. Applicant's election without traverse of Group I, drawn to claims 1-5, in the reply filed on October 14, 2008 is acknowledged. Claims 6-14 have been withdrawn from consideration as being directed to a non-elected invention. See 37 CFR 1.142 and MPEP §821.03. Claims 15-20 have been cancelled.

Drawings

2. Drawings are required in this application because the drawings that are within the body of the specification were not provided with the application.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 1-5 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 1 states "the solid electrolyte consisting of the inner nanoporous three-dimensional solid electrolyte layer with a grain size of within 1000 nm which fills, at least partially, the surface pores of the microporous electrode to a depth of 5 – 50um, and a dense outer electrode layer with a grain size of within 1000 nm located on the surface of said inner layer." In particular, "within 1000 nm" is indefinite. It is unclear if this is intended to mean 0-

1000nm in size or a grain size with a maximum differential of 1000nm between the grains, for example a grain size between 4000-5000nm, or another different meaning. Further, it is believed by the examiner that "a dense outer electrode layer" is meant to say "a dense outer *electrolyte* layer". Applicant is asked to clarify.

5. Claims 1-5 recite the limitations "Electrode-electrolyte pair" in Line 1 of claims 1-8 and "the inner nanoporous three-dimensional solid electrolyte layer" in Line 3 of claim 1. There is insufficient antecedent basis for these limitations in the claims. Independent claim 1 should be rewritten as "an electrode-electrolyte pair" while dependent claims should refer to "the electrode-electrolyte pair according to claim 1," and claim 1 should refer to "*an* inner nanoporous three-dimensional solid electrolyte layer." Appropriate correction is required.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.

4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

8. Claims 1-2 and 5-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Isenberg (US4,702,971) in view of Del Gallo et al. (US6,475,657) and Talbot et al. (US6,752,974).

With respect to claim 1, Isenberg discloses a solid oxide fuel cell comprising a microporous electrode (6) made of metal particles (11) on which is deposited a yttria stabilized zirconia (YSZ) electrolyte (5). See col. 3, lines 20-48; Figures 2 and 3. Further, partially surrounding the metal particles (11) is an ion conducting metal oxide (12) also made of YSZ. See col. 3, line 65-col. 4, line 15; Figures 2 and 3. The metal particles (11) of the electrode are between 1 micron to 5 microns in diameter and the electrode thickness is about 50 microns to 200 microns. See col. 3, lines 40-64. The ion conducting metal oxide (12) binds the metal particles (11) to the electrolyte (5) and thus fill, at least partially, the surface pores of the electrode to a depth of 2-50μm.

Isenberg is silent with respect to the solid electrolyte layers being stabilized bismuth oxide. Del Gallo et al. disclose a solid oxide fuel cell having a solid electrolyte that is made of a doped, i.e. stabilized, metal oxide. The stabilized metal oxides include zirconia and bismuth oxide. See Column 4, Lines 1-45. It would have been obvious to one of ordinary skill in the art at the time of the invention to use the alternative of doped ceria of Del Gallo et al. for the YSZ electrolyte material of Isenberg, because Del Gallo et al. teach the use of doped bismuth oxides are preferred at the operating temperature.

Isenberg modified by Del Gallo et al. are silent with respect the electrolyte material being combined amorphous and crystalline structure. Talbot et al. disclose a method for producing

metal oxide particles having grain sizes less than a micrometer in size for use in solid oxide fuel cell electrolytes. See col. 1, lines 1-20. Talbot et al. disclose that nanometer sized grains of metal oxides will beneficially have lower sintering temperatures, very high surface areas, and improved physical properties as compared to larger sized grains. See col. 1, lines 29-37. The method as disclosed by Talbot et al. produces particles that are substantially crystalline and contain small amounts of amorphous material. See Column 10, Lines 34-36. It would have been obvious to one of ordinary skill in the art at the time of the invention to utilize particles as made by Talbot et al. in the metal oxide of Isenberg because Talbot et al. teach that they have lower sintering temperatures, higher surface areas and improved physical properties.

With respect to claim 2, Isenberg discloses the electrolyte dense electrolyte layer (5) and the inner electrolyte layer (12) to be made of the same composition, as discussed above with respect to claim 1.

With respect to claim 3, Isenberg discloses doping with rare earth elements or yttria. See col. 3, lines 20-39.

With respect to claim 4, Isenberg discloses the electrode to be an anode of a pipe-like shape. See Figure 1.

With respect to claim 5, Isenberg discloses a metallic electrode made of particles between 1 to 5 microns in diameter. See col. 3, lines 49-64. The metal powder forms an electrode that is approximately 50% porous. See col. 5, line-col. 6, line 3. This means that the pore sizes would thus be between 1 to 5 microns in diameter to allow for the porosity of the electrode to be 50%.

Contact/Correspondence Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Steven Scully whose telephone number is (571)270-5267. The examiner can normally be reached on Monday to Friday 7:30am to 5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Dah-Wei Yuan can be reached on (571)272-1295. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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/S. S./
Examiner, Art Unit 1795

/Dah-Wei D. Yuan/
Supervisory Patent Examiner, Art Unit 1795